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THE NEW ORGANIC CHEMISTRY.

Chemie der alicyklischen Verbindungen. By Prof. Ossian Aschan. Pp. xlv + 1163. (Brunswick: Vieweg und Sohn, 1905.) Price 40 marks.

FEW reflections are more curious than those which contrast the manifold complexity of the organic chemistry of the present day with the crude simplicity of the fundamental conceptions upon which it has been built up. Broadly speaking, these conceptions are but two in number—first, the almost repulsively mechanical atomic theory of Dalton, which we still retain in practically its original form, and second, the irritatingly mysterious doctrine of valency introduced by Frankland and Kekulé, also still preserved much as it was enunciated, but which eludes our grasp and sets us chasing shadows so soon as we attempt to translate it into definite mechanical conceptions. Yet, on the ground-work afforded by these two conceptions, so irreconcilable in their nature and so hopelessly crude in the eyes of the physicist, the organic chemist has built up a purely experimental science which embraces hundreds of thousands of different substances within a scheme as perfect as any known to science, which classifies with similar perfection the reactions by means of which those substances are produced and the behaviour which they exhibit, and has led to the synthetic preparation of hosts of compounds the production of which our immediate predecessors regarded as amongst the most intimate secrets of animal and vegetable life.

This result has been attained by the systematic development of experimental methods, and by applying those methods, as they became sufficiently powerful, to the consecutive study of the diverse classes of compounds occurring in organic chemistry. Long ago, experimental methods were sufficiently strong to permit of their successful application to large numbers of aromatic compounds. To-day, the rough methods of the older chemists have become largely superseded by far more delicate ones, by methods which render possible the building up, piece by piece, of the fragile molecular structures numbered amongst the alicyclic compounds. The organic chemist has probably always realised the filamentary character of his hypotheses, and, knowing that he has no prophetic or far-reaching mathematical theory with which to eke out his own cunning, has been led to rely very largely upon his own manipulative skill. For this reason, and more especially is this the case in the branch of the subject now under consideration, organic chemistry partakes of the nature of an art as much as of that of a science, and to be successful, the organic chemist must be endowed with a sort of intuition which education cannot impart and instruction cannot destroy.

The systematic study of the alicyclic compounds dates back only some twenty-five years. At that time the wonderful successes achieved amongst the aromatic compounds by Kekulé and his followers seem almost to have suggested that all complex organic substances might be benzene derivatives. One of the most important alicyclic compounds known to us, namely, camphor, was formulated by Kekulé as an aromatic substance, and for long the Kekulé constitution for camphor held its own, in spite of objections raised by Armstrong and others. Gradually, however, as the early work of Freund, and especially of W. H. Perkin, jun., was developed, it became clear that benzene derivatives are not the only possible closed chain carbon complexes, and derivatives of 3, 4, 5, and 6 membered closed carbon chains were prepared synthetically; it was thus demonstrated that there exist in nature many important closed ring compounds which belong to a class totally different from that of the aromatic compounds, and which may be termed, as Bamberger first suggested, the alicyclic compounds.

A work like the present, which aims at giving a full and complete account of all that has been done in a subject which has grown so rapidly, and is even yet but in its childhood, is greatly needed, and probably no one is better equipped for successfully carrying out the colossal task involved in its production than Prof. Aschan, of Helsingfors. For the worker in this subject, such a book as Aschan has produced is invaluable, if only as an aid to the mnemonic arrangement of his knowledge, and for the student, face to face with the task of studying hundreds of lengthy memoirs, such a classified digest of the whole subject as is here provided offers invaluable indications as to what must be read and what may be safely disregarded.

The classification adopted in the work consists primarily of a division into a general and a special part; further, each division of the subject is ushered in by an historical introduction, which is both interesting and of considerable educational value as leading up, tersely and plainly, to the main theme. The general part includes an introductory chapter defining the scope of the subject dealt with, a theoretical discussion relating to the development of the subject, a discussion as to the influence of ring formation upon the chemical and physical properties of ring compounds, and an exposition of the stereochemistry of alicyclic substances. The special part comprises a systematic description of the methods of formation and preparation of alicyclic compounds, followed by a detailed and equally systematic presentation of our present knowledge of monocyclic, bicyclic, tricyclic, and polycyclic carbon compounds.

The variety of types and the complexity of detail involved in the study of the alicyclic compounds possibly make essential the primary division of the work into a general and a special part; the instances which can be quoted in which some repetition results from the introduction of a general summary as a preliminary to the detailed section are therefore, perhaps, unavoidable in a work of this kind. At the same time, any duplication of matter in the general summary and the detailed description has some drawbacks, because it increases the actual number of pages to be got through without essentially affecting the amount of information which is imparted: and the stream of literature incessantly poured upon the unfortunate chemist is now so voluminous that few can attempt to read even the most interesting work in detail; the pages have to be merely skimmed through, and the task of forming and storing an adequate visualisation of the whole is possible only to the highly trained memory.

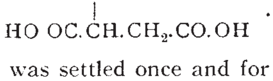
The general arrangement of the book, although highly systematic, sometimes leads to difficulties in finding any desired subject. Thus, the dihydrophthalic acids are dealt with on p. 827, the tetrahydrophthalic acids on p. 771, and the hexahydrophthalic acids on p. 702; yet all these substances were prepared by v. Baeyer at the same time and described in the same paper. The difficulty of finding one's way about the book would, however, be far greater were it not for the excellent index and detailed table of contents.

In the sections devoted to the terpenes and the camphor group, we cannot but miss the spirit of selection and criticism which lends such fascination to the account of the same branch of organic chemistry given by Prof. Harries in Meyer and Jacobson's "Handbuch der organischen Chemie." But, after all, Aschan's book is so replete with valuable detail that any serious attempt on his part to exercise the critical faculty might have impaired the usefulness of the whole work. At the same time, the value of the book as a comprehensive digest would certainly be the greater if more stress had always been laid on investigations which really mark an epoch. Thus, the brief mention made on pp. 501 and 563 of Perkin and Thorpe's recent synthesis of α-campholytic and isolauronolic acids appears quite inadequate in view of the way in which this synthesis cleared the field and settled definitely the question of the constitutions of these two important acids.

A similar objection may be raised in connection with the otherwise excellent discussion of the constitution of pinene on pp. 170 to 186, from which it is by no means easy for the casual reader to discern the really essential points in the complicated argument. The whole discussion relating to this problem centred for a long time upon the constitution of isocamphoronic acid, and for this Tiemann and Semmler offered the formula

$$HO.OC.CMe_2.CH(CH_2.CO.OH)_2,$$

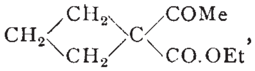
whilst v. Baeyer suggested



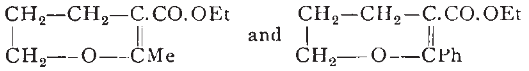
$$\begin{array}{l} \qquad\quad CMe_2.CH_2.CO.OH \\ \qquad\quad | \\ HO\ OC.CH.CH_2.CO.OH \end{array} .$$

The discussion was settled once and for all by Perkin, who prepared both these acids and proved thereby that the Tiemann and Semmler constitution correctly represents isocamphoronic acid. No mention seems, however, to be made in the work of these two syntheses, although they are vital to the argument.

In such a comprehensive work as the one under consideration it is surprising that so few slips and omissions occur. On p. 22, lines 13 to 32, and p. 23, lines 10 to 37, the action of sodioacetacetic ester upon trimethylene bromide is stated, in accordance with the original paper of 1883, as leading to the formation of acetyltetramethylenecarboxylic ester,



but no mention is made of Perkin's subsequent demonstration that this reaction, both in the case of acetacetic and of benzylacetic ester, really leads to the production of oxygenated ring compounds, thus:—



$$\begin{array}{l} CH_2—CH_2—C.CO.OEt \\ |\qquad\qquad\quad \| \\ CH_2—O—CMe \end{array} \quad \text{and} \quad \begin{array}{l} CH_2—CH_2—C.CO.OEt \\ |\qquad\qquad\quad \| \\ CH_2—O—CPh \end{array}$$

although when sodiomalonic ester is employed a tetramethylene derivative actually results. The reaction is correctly stated in the special part of the work at p. 418.

Further, on p. 38, v. Baeyer's old condensation of three molecules of malonic ester into one of phloroglucintricarboxylic ester is still figured in all that simple symmetry which constitutes one of the glories of our elementary text-books. No mention is made of Moore's proof (*Trans. Chem. Soc.*, 1904, 165) that the product is really the phloroglucindicarboxylic ester of Bally, although v. Baeyer himself refers to the correction in his recently published collected works.

A curious slip occurs on p. 585—probably as the result of confusion with the work of Zelinsky—where Perkin and Haworth are represented as having prepared hexamethylene by the action of sodium on *bromocyclohexane* in boiling *alcoholic* solution, but where an equation is given representing the action of sodium on hexamethylene bromide. The synthesis was actually effected by the action of sodium on hexamethylene bromide in metaxylene solution; the action of sodium in boiling alcoholic solution would obviously have led to the production of normal hexane.

A valuable section is devoted to the discussion of the stereochemical relationships which may exist between isomeric alicyclic compounds, and the elucidation of the isomerism is materially facilitated by the use of carefully designed figures; the somewhat intricate stereochemistry of these substances can hardly be brought home to the reader more clearly than is here done. On p. 354 an erroneous constitution is assigned to isolauronic acid, and the deduction drawn therefrom that this acid can exist in four optically active modifications; isolauronic acid actually contains no asymmetric carbon atom, and, as is clear from the correct constitution assigned to it on p. 698, is incapable of exhibiting optical activity.

The section dealing with irone, ionone, and allied substances possessing the odour of violets forms a particularly lucid exposition of the finest piece of work done by Tiemann. Amongst the copious references given is to be noted one of the first fruits of the system of abstracting chemical patents introduced into the *Chemisches Centralblatt* during the last few years. Now that so much of the pioneer work in organic chemistry appears for the first time in patent specifications, references to the patent literature are as necessary as references to the ordinary scientific journals.

In reading chemical compilations of German origin we are sometimes struck by the scant attention received by work done in this country, and are often forced thereby to the conclusion that the author's study of English chemistry is limited to the system of abstracts issued by the Berlin Chemical Society. No such fault can be found here; the author is obviously as much at home in the Journal of the Chemical Society as in the Continental journals, and gives full credit to all results, from whatever source they are derived.

For Aschan's new book, as a whole, nothing but praise is possible, and the few points to which objections have been made rank as nothing when regarded as raised from the perusal of a book 1200 pages long, which aims at giving a systematic account of the alicyclic compounds. The study of these substances has been mainly carried out at fever heat during the past quarter of a century, and the necessarily ragged way in which the results have been laid before the world in the current journals must have offered immense difficulties to the compiler.

We cannot close this book, containing as it does a lucid account of one of the most important and intricate sections of organic chemistry, without reflecting with pleasure that the intense but systematic work which has led, during the last twenty years, to the synthetic building up of such complex molecular structures as those of camphor and of the terpenes has been largely carried out in our own country.

W. J. P.

THE SYSTEM OF THE FIXED STARS.

Der Bau des Fixsternsystems mit besonderer Berücksichtigung der photometrischen Resultate. By Prof. Hermann Kobold. Pp. xi+256. (Brunswick: Vieweg und Sohn, 1906.) Price 5.60 marks.

TO prove that the stars form a stable system is a problem that has had attractions for many philosophical minds. The problem has not been solved, possibly may not be capable of solution, but the attractiveness of the speculation remains. Analogy with the solar system has suggested, and given support to, such an idea. The harmony that is to be perceived in the ordered motions of the planets, permitting countless revolutions to be performed without permanent change or irregularity, might well give rise to the hope that the same principle that governs the solar system could be detected in the larger scheme of the stellar universe. Such an idea would naturally have sway at a time when speculation was little fettered by numerical data drawn from rigorous observation. If there was little evidence to support the notion, there was nothing to contradict it. Kant or Lambert could suggest without difficulty that the stability of the system was secured by each star moving in a definite orbit, which ensured the maintenance of the general form and arrangement. The influence that that thought has exercised on modern investigation is of more importance than the thought itself. To suspect the influence of the Milky Way in the scheme of the Cosmos, and to make its investigation the centre of inquiry, was to bequeath us a legacy which is by no means exhausted. Later schemes suggested by improved instrumental appliances have widened the scope and raised fresh issues, but the significance of the Milky Way remains. Similarly with the problem of the sun's motion, which a hundred years ago Herschel solved so satisfactorily, considering the character of his material. Disputed by Bessel and supported by Argelander and a host of later astronomers, the solution has passed through many stages and given rise to novel methods of treatment, involving the application of fresh hypotheses. In these later times we have pressed into the service the results brought to light by the spectroscope, especially difficult of interpretation as they are, and allowing the exercise of much ingenuity. But the essential problem remains the same. The only question is, What advances have we made in solving the riddle which perplexed earlier investigators?

In proportion as the problem becomes more and more complicated, either by repetition of similar processes or the introduction of fresh ones, the greater is the necessity for the examination of the evidence to test its value in combination, and of bringing the whole material to bear in one consecutive argument. This is the task which Dr. Kobold has undertaken, and in which he has acquitted himself with credit. One may not in every case draw the same conclusion, or with the same certainty, that the author does, but the evidence is at least presented with completeness, and we have the opportunity of bringing our critical faculty to bear upon the various lines of argument which are marshalled in review. Such a book is instructive to the tyro and suggestive to the expert. The one may adopt the conclusions which the author has drawn up, as indicating the general position of science towards this problem, the other may see the necessity for pursuing fresh lines of research, or of supporting alternative explanations of the results presented. In any case it is an advantage to see what has been attempted and what has been accomplished.

The author divides his book into three sections. In the first he describes on broad lines how the facts which may aid in solving the problem of the construction of the universe have been collected. The reader who comes fresh to this subject, without any previous acquaintance, gains an intelligent notion of the manner in which the positions of the stars have been ascertained, and can grasp clearly the supreme importance of an accurate determination of the precession constant when the question of proper motion is considered. The brilliancy and the colour of stars are both discussed, though the practical bearing of the latter point on this particular problem is not very clear, and in any case is more conveniently dealt with in discussing the spectroscopic observations, which are also brought under notice. Parallax and stellar distribution are adequately described, and therefore in this section we get a tolerably complete sketch of the main processes of stellar observation, except in